Differentiation of Trigonometric Functions

Trig Function	Derivative
$\sin x$	$\cos x$
$\cos x$	$-\sin x$
$\tan x$	$(\sec x)^2$ or $\sec^2 x$
$\operatorname{cosec} x$	$\operatorname{cosec} x \cdot \cot x$
$\sec x$	$\sec x \cdot \tan x$
$\cot x$	$-(\operatorname{cosec} x)^2$ or $-\operatorname{cosec}^2 x$

If the trig function is also a ***composite*** function, use the differentiation rule:

If $y = f(g)$, then $y' = f' \times g'$.

Example: Differentiate these trig functions.

1) $y = 3\cos 5x$ $\quad y' = 3 \cdot -\sin 5x \cdot -5 = 15\sin 5x$

2) $y = 6\cot(2x+3)$ $\quad y' = 6 \cdot -\operatorname{cosec}^2(2x+3) \cdot 2 = -12\operatorname{cosec}^2(2x+3)$

3) $y = \tan(3x^2 - 4x)$ $\quad y' = \sec^2(3x^2-4x) \cdot (6x-4)$

$$= (6x-4)\sec^2(3x^2-4x)$$

4) $y = 2\cos(\sqrt{x}\,)$ $\quad y = 2\cos(x^{1/2})$

$$y' = 2 \cdot -\sin(x^{1/2}) \cdot \tfrac{1}{2}x^{-1/2} = -x^{-1/2} \cdot \sin(x^{1/2})$$

$$= \frac{-1}{x^{1/2}} \cdot \sin(x^{1/2}) = \frac{-\sin(\sqrt{x})}{\sqrt{x}}$$

5) $y = \frac{3}{\sqrt{\sin(2x)}}$ $\quad y = \frac{3}{[\sin(2x)]^{1/2}} = 3 \cdot [\sin(2x)]^{-1/2}$

$$y' = 3 \cdot -1/2 \cdot [\sin(2x)]^{-3/2} \cdot \cos(2x) \cdot 2$$

$$= -3 \cdot \cos(2x) \cdot [\sin(2x)]^{-3/2} = \frac{-3\cos(2x)}{[\sin(2x)]^{3/2}}$$

6) $y = \sin[\cos(x)]$ $\quad y' = \cos[\cos(x)] \cdot -\sin(x) = -\sin(x)\cos[\cos(x)]$

7) $y = \sin^3(x-\pi)$ $\quad y = [\sin(x-\pi)]^3$

$$y' = 3 \cdot [\sin(x-\pi)]^2 \cdot \cos(x-\pi) \cdot 1$$

$$= 3\cos(x-\pi)\sin^2(x-\pi)$$

Delta Ex 9.1, Ex 9.3 pg 98